EFFECT OF AGING DAYS ON TENDERNESS AND MYOFIBRILLAR PROTEIN DEGRADATION OF FIVE MUSCLES FROM HANWOO BULL WITH DIFFERENT QUALITY GRADE

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Abstract –This study investigated the effect of aging on tenderness of Hanwoo bull beef with different quality grade. Five muscles were obtained from twelve Hanwoo bulls by the Korean meat quality grade (QG 2, n=5; QG 2, n=7). *Psoas major* muscle (PM), *longissimus thoracis* muscle (LT), *longissimus lumborum* muscle (LL), *longus colli* muscle (LC) and *semimembranosus* muscle (SM) were vacuum packed then stored for 2, 6, 10, 14, 21, 28 and 35 d at 4°C and Warner-Bratzler shear force (WBSF) values were measured. Tenderness levels were classified depending on WBSF values as tough zone (> 3.9 kg), tender zone (3.2~3.9 kg) and very tender zone (< 3.2 kg). PM was the most tender among five muscles during cold storage. Especially, WBSF values of PM with QG 2 attained the very tender zone at 2 d, and those with QG 3 attained the very tender zone at 10 d. LT with QG 2 attained the very tender zone at 14 d. WBSF values of LL, LC and SM did not attain the very tender zone during cold storage until 35 d. Therefore, the results of our study suggested that aging effects on tenderness of Hanwoo bull beef may be related to the muscle types.

Key Words – beef, muscle fiber, shear force value

I. INTRODUCTION

World trade in beef is expected to increase despite the small setbacks resulting from the recent global financial crisis. In fact the various flows of the international meat trade are becoming more complex, with many more countries of the world participating often as both an importer and exporter. The methods of storage and transport have become more sophisticated allowing a very high quality product to be traded and a large proportion of meat is now boned before export.

The most important aspect of beef quality is the sensory or eating quality, defined as tenderness, juiciness and flavor, usually assessed by a trained taste panel [1]. South Korean consumers prefer high marbling rather than high lean meat in beef. The reason is because high marbling aged beef is more tender than non-aged or low marbling beef. As a result, market share of Hanwoo steer beef and cow beef has been increasing whereas Hanwoo bull beef is 10% of the levels of total Hanwoo beef distribution in South Korea.

Therefore, the purpose of this study was to investigate the effects of aging time on tenderness from Hanwoo bulls with different quality grades.

II. MATERIALS AND METHODS

The intramuscular fat content was analyzed using FoodScan (78810, Foss, Denmark) according to the method of Anderson *et al*. [2].

The twelve Hanwoo bulls were from the Korean meat quality grades (QG 2, n=5; QG 3, n=7). Five different muscles from Hanwoo bulls were selected *psoas major* muscle (PM), *longissimus thoracis* muscle (LT), *longissimus lumborum* muscle (LL), *longus colli* muscle (LC) and *semimembranosus* muscle (SM) and vacuum packed then stored for 2, 6, 10, 14, 21, 28 and 35 d at 4°C.

All samples were measured for Warner-Bratzler shear force (WBSF) values using an Instron (5543, USA). Obtained data were classified as follows;

WBSF < 3.2 kg, “Very Tender Zone”
WBSF = 3.2 - 3.9 kg, “Tender Zone”
WBSF > 3.9 kg, “Very Tough Zone”

SDS-PAGE patterns of myofibrillar protein degradation during cold storage from five muscles of Hanwoo bull was performed according to the method of Laemmli [3].

III. RESULTS AND DISCUSSION

Table 1 shows the intramuscular fat content of five muscles from Hanwoo bull with different quality grade. SM with QG 2 showed higher ($p<0.05$) intramuscular fat than that of the QG 3. However, PM, LT, LL and LC showed no difference between QG 2 and QG 3 in intramuscular fat content.

Warner-Bratzler shear force values of five muscles from Hanwoo bulls with different quality grade (QG; 2, 3) during cold storage are shown in Figures 1-5. PM irrespective of quality grade belonged to the ‘Very Tender Zone’ after cold storage at 2 d (Figure 1). LT belonged to the ‘Tender Zone’ cold storage at 6 d (QG 2), 10 d (QG 3), respectively (Figure 2). Also, LD belonged to the ‘Very Tender Zone’ after 14 d (QG 2) and 35 d (QG 3) cold storage. However, LL of all QG (2, 3) remained tough until 28 d cold storage (Figure 3). LC of all QG belonged to the ‘Tender Zone’ at 21 d of cold storage (Figure 4). However, SM of all QG remained tough until 35 d cold storage (Figure 5). Also, those samples were not in the ‘Tender Zone’ during 35 d cold storage. Gruber *et al*. [4] also found similar results as the quality grade of beef cuts increased. Park *et al*. [5] reported that tenderness of Korean cow beef was related to intramuscular fat content in cuts such as the *longissimus* muscle and the PM.

This result suggested that PM and LT from Hanwoo bulls of QG 2 were more tender ($p<0.05$) compared to QG 3. LC of QG 2 were more tender compared to QG 3, however, not significantly different ($p>0.05$). On the other hand, LL and SM showed no difference between QG 2 and QG 3 in patterns of Warner-Bratzler shear force values.

Figures 6-10 show the degradation of myofibrillar proteins according to electrophoresis. Myosin degradation of LL, LC and SM occurred at 10 d, 14 d and 21 d of cold storage, respectively.

Overall, these data imply that tenderness from Korean bulls may be related to muscle type such as PM.

Table 1. Comparison of intramuscular fat content (%) from Hanwoo bull with different quality grade

Muscles	Quality grade		SEM
	2 (n=5)	3 (n=7)	
Psoas major	7.46	5.14	0.84
Longissimus thoracis	10.79	7.70	1.13
Longissimus lumborum	7.45	5.69	0.70
Longus colli	4.28	3.99	0.52
Semimembranosus	4.03*	2.39	0.32

*$p<0.05$.

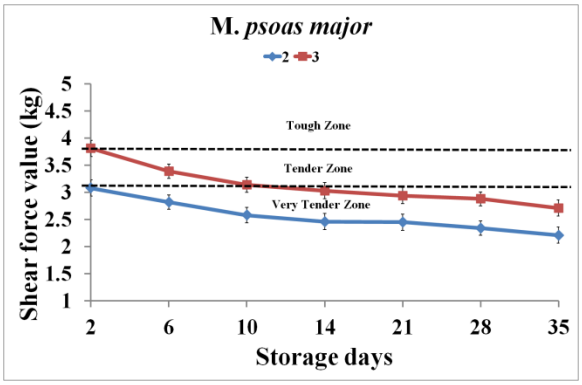

Figure 1. Changes in Warner-Bratzler shear force values of *psoas major* muscle from Hanwoo bull with different quality grade during cold storage.

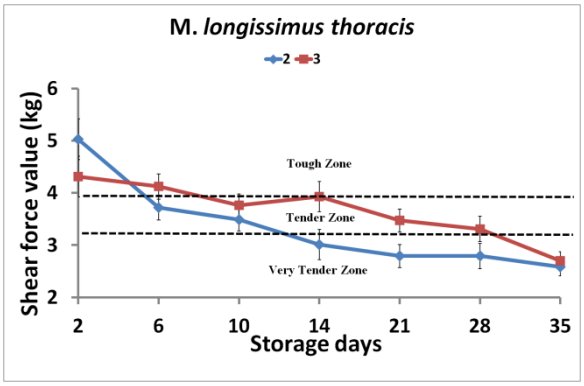

Figure 2. Changes in Warner-Bratzler shear force values of *longissimus thoracis* muscle from Hanwoo bull with different quality grade during cold storage.

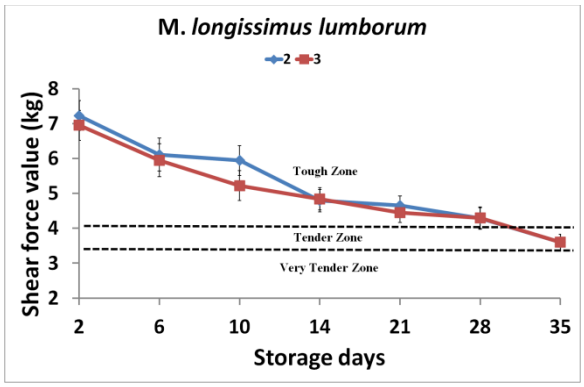

Figure 3. Changes in Warner-Bratzler shear force values of *longissimus lumborum* muscle from Hanwoo bull with different quality grade during cold storage.

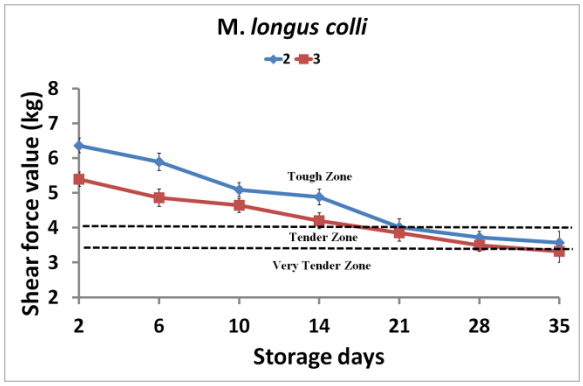

Figure 4. Changes in Warner-Bratzler shear force values of *longus colli* muscle from Hanwoo bull with different quality grade during cold storage.

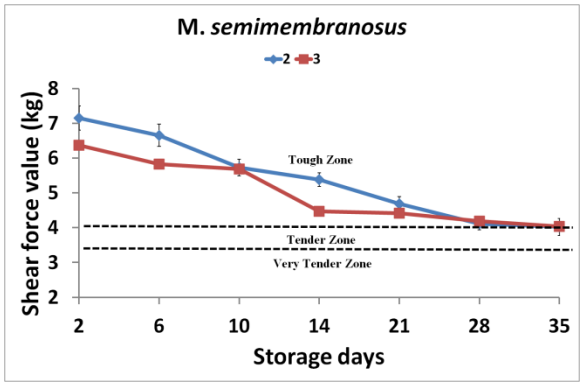

Figure 5. Changes in Warner-Bratzler shear force values of *semimembranous* muscle from Hanwoo bull with different quality grade during cold storage.

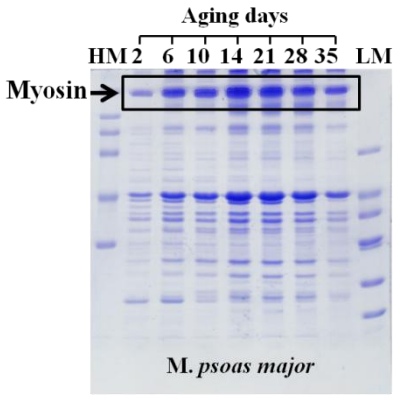

Figure 6. SDS-PAGE patterns of myofibrillar protein fractions of *psoas major* muscle from Hanwoo bull of quality grade 2 during cold storage. HM = protein high molecular mass standards; LM = protein low molecular mass standards.

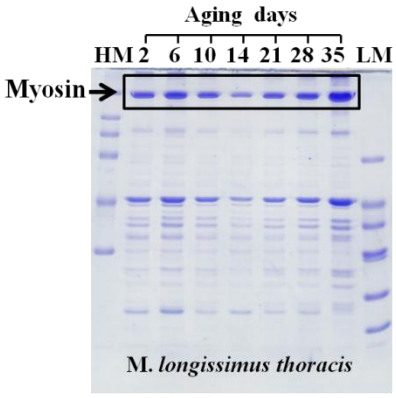

Figure 7. SDS-PAGE patterns of myofibrillar protein fractions of *longissimus thoracis* muscle from Hanwoo bull of quality grade 2 during cold storage. HM = protein high molecular mass standards; LM = protein low molecular mass standards.

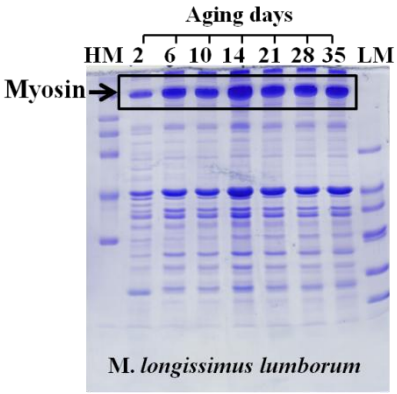

Figure 8. SDS-PAGE patterns of myofibrillar protein fractions of *longissimus lumborum* muscle from Hanwoo bull of quality grade 2 during cold storage. HM = protein high molecular mass standards; LM = protein low molecular mass standards.

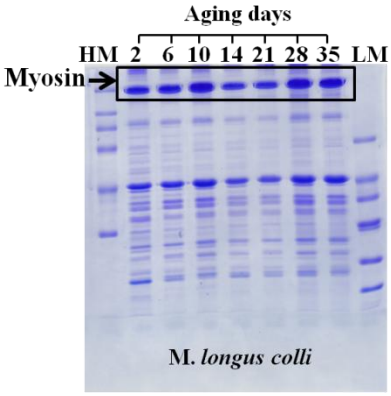

Figure 9. SDS-PAGE patterns of myofibrillar protein fractions of *longus colli* muscle from Hanwoo bull of quality grade 2 during cold storage. HM = protein high molecular mass standards; LM = protein low molecular mass standards.

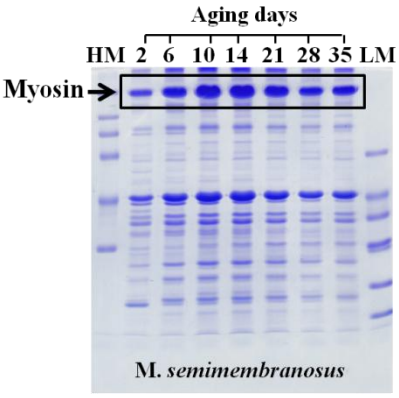

Figure 10. SDS-PAGE patterns of myofibrillar protein fractions of *semimembranosus* muscle from Hanwoo bull of quality grade 2 during cold storage. HM = protein high molecular mass standards; LM = protein low molecular mass standards.

IV. CONCLUSION

Therefore, our results suggested that tenderness from Korean bulls may be related to intramuscular fat content in the *longissimus* muscle or muscle type in the *psoas major* muscle.

ACKNOWLEDGEMENTS

This research was supported by Grant from the Korean Rural Development Administration. The authors acknowledge a graduate fellowship provided by the Rural Development Administration through the Agenda system Projects, Korea.

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